

Ion Exchange at Metal–Ceramic Interfaces

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Objectives:

- To study ion-exchange diffusion reactions at planar spinel-metal interfaces, made with and without applied electrical fields.
- To model (and validate) the electrostatic mechanism of mechanical adhesion at such interfaces, and relate it to ion-exchange.

A New Result:

Thin films of aluminum deposited on spinel (MgAl_2O_4) were found to gradually “dissolve” into the spinel upon annealing. This Kirkendall-type of phenomenon will be used to measure the difference between the inward diffusion of aluminum and the outward diffusion of magnesium from the spinel. The asymmetry in interdiffusion and the difference in the valency of the exchanging ions suggests a correlation between interdiffusion and electrical fields, which is conceptually consistent with the electrostatic model of mechanical adhesion.

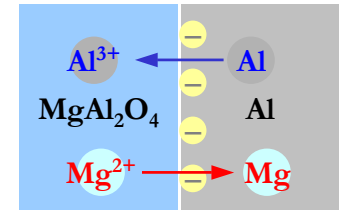


Fig. 1 Ion-exchange model.

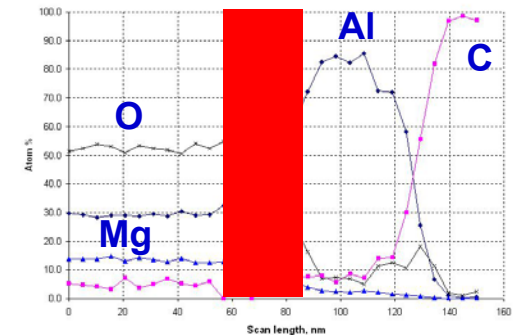
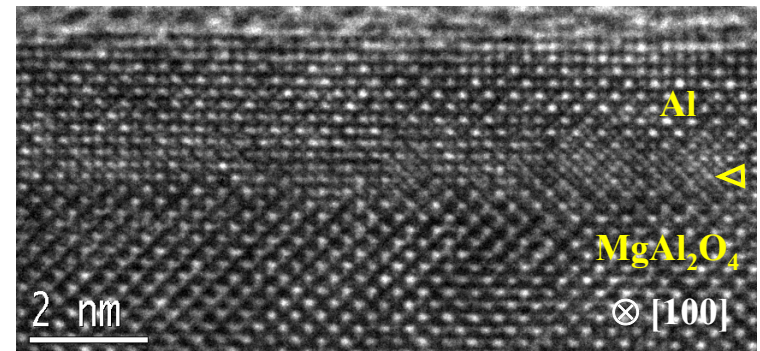


Fig. 2 XEDS line profile.

Fig. 4 HRTEM image after annealing.



Education, Outreach and Mentoring

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In December 2002 and January 2003, the team at CWRU invited 7th and 8th graders of the Ruffing Montessori middle school in Cleveland Heights for two lectures on "Materials and Microscopy" and a hands-on demonstration of scanning electron microscopy and transmission electron microscopy. For each event, the science teacher, C. Seidman, selected a group of 10 excellent students. The school reported about their visit to CWRU on the internet and in the journal of the school.



Demonstration of the new high-resolution electron microscope Tecnai F30 at CWRU (acquired with financial support from NSF).